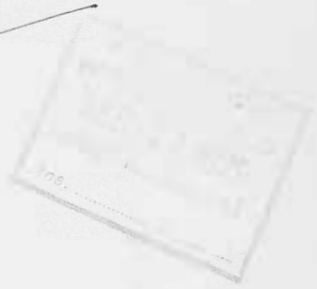
FOREST PROTECTION
BOARD

1929



REPORT

ON

FOREST INSECT SITUATION

By

DR. F. C. CRAIGHEAD

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Summary

The annual losses in merchantable timber from tree-killing insects are conservatively estimated at from $15,000,000 to $20,000,000. About one half of this loss occurs on Government-owned lands. Such an estimate does not take into consideration esthetic and protective values in the national parks and recreational areas, or the increased fire hazard of standing dead insect-killed timber. Forest insects also seriously handicap the efforts to put these timber lands on a sustained yield basis.

More adequate protection of Government-owned timber lands is necessary (1) to reduce losses in merchantable timber, (2) to insure protection of areas of great scenic value, (3) to bring about a further reduction of the fire menace, and (4) to provide better insurance in certain timber growing enterprises.

Cooperation among the various Federal agencies and private timberland owners is just as necessary in protection from and control of insects as in the case of fire. Inter-bureau cooperation and Government cooperation with private timberland owners has developed satisfactorily. The Bureau of Entomology is responsible for research and investigation of the destructive insects, and this serves as a basis for the development of control methods. It also acts as a clearing house on all technical matters pertaining to control and renders service to other Federal agencies and private timberland owners in giving recommendations as to the advisability of, and methods for, control. It is the part of the various land managing agencies to conduct the actual control work. In larger control projects a representative of the Bureau of Entomology is usually detailed to the project.

There are two distinct classes of timberlands needing protection from insect pests - (1) those where the present or future commercial value is the chief consideration, and (2) those where the esthetic values are predominant. The stands of saw timber subject to insect depredations on the Federally owned lands, exclusive of national parks, amounts to about 238,000,000,000 board feet. Estimates for national parks are not available but in this case an area of 3,787,210 acres is in need of protection.

Since 1906 varying amounts have been available for insect control work, and in 1924 special provision to meet this form of protection was authorized for the Forest Service and later the National Park Service. The funds available, however, have never been adequate to meet the needs. More adequate protection is

(Over)

good insurance since, if it were possible to control them in the incipient stages, these outbreaks could be prevented from reaching such destructive proportions.

The recommendations of the Forest Protection Board for more adequately meeting this situation are presented in a separate report approved April 1, 1929.

I.

The Insect Situation

The destruction of standing timber from insect attack is of such importance as to warrant ranking it along with fire in considering the need of forest protection. These losses are frequently compared to those resulting from fire, and it is now generally recognized that more timber is destroyed by insects than by fire. In making this comparison, however, there is no intention of claiming that the problems of forest entomology are of more economic importance than those of fire. An effort is made to suppress all fires within our forests regardless of their size or location, which reduces the fire loss to a minimum. On the other hand insect outbreaks are for the most part uncontrolled, so in reality a maximum insect loss is compared to a minimum fire loss.

It must be further understood that in drawing this comparison of losses from insects and from fire, an expenditure of funds on a parallel to that for fire suppression is not anticipated. A certain per cent of this destruction by insects occurs in what is called normal or endemic infestations in timber stands of such low commercial values that an expenditure for control would not be warranted. These losses are inevitable and are in most cases absorbed by the annual increment of the stand.

The loss in the western part of United States from tree-killing barkbeetles alone amounts to something like 5,000,000,000 board feet annually. Defoliating insects likewise take an annual toll of approximately 1,000,000,000 feet. It can be conservatively estimated that from $15,000,000 to $20,000,000 worth of saw timber are lost each year from insect depredations.

Such a picture does not attempt to appraise insect losses in areas of great scenic value. The importance of the forest cover in national parks, game preserves, and recreational areas cannot be estimated in monetary values. Here the esthetic and protective values far outweigh those of the commercial timber. Although not so directly appreciated by the visitor one of the greatest attractions in these areas is the forest, as much of the natural beauty of parks, camp sites, etc., is in reality dependent upon a green forest cover. Trees also give protection to the birds and animals. For these reasons insect depridations which mar the scenic beauty or destroy the protective value of the forest cover must be controlled regardless of cost.

Occasionally there is need of insect control because of the fire menace created. When extensive outbreaks of insects develop in forest types composed chiefly of one species of tree a high percentage of the stand may be destroyed. These standing dead trees go down in the course of a few years making an almost impenetrable tangle of logs and tops. Under proper conditions a flash of lightning may set off the mass resulting in a widespread conflagration almost impossible to fight. Past experience has shown that epidemics of the mountain pine beetle in lodgepole have been followed by fires more often than not.

The old snags of insect-killed trees scattered throughout our mature forests, which average for some areas as many as ten per acre, stand for many years and greatly increase the cost, difficulty, and danger in fire control. Snag felling is required in many sales of national forest timber, and many private operators have already adopted this regulation. The increased cost of control of fires which have spread from burning snags within fire lines would alone justify insect control even at a high cost.

There is another less advertised, though each year increasingly more important, aspect of the insect activities in our forests. In some forest types insects often are one of the chief limiting factors in successful management. Insects frequently "throw the monkey wrench," so to speak, into our well organized plans aimed at the production of continuous forest crops. In the white pine and lodgepole types of the northern Rockies barkbeetles so affect the proportion of species in these stands as to convert the resulting forest into one of entirely different composition, often of inferior species, necessitating an entire reorganization of management plans.

Much progress has been made in recent years toward establishing sustained yield on both Federal and private timber lands in the western yellow pine type of California and Oregon. The management of these stands is based on an initial partial cutting, leaving a sufficient reserve of timber for future growth so as to enable a second cutting in from 30 to 40 years. Barkbeetle losses in these stands reserved for future growth have in certain areas not only offset all increment but have reduced the original capital from 1 to 15 per cent. Further progress in this much desired movement will necessitate a thorough-going investigation as a basis for the prevention of these insect losses.

To summarize, the reasons for more adequate protection of Government-owned timberlands are - 1, to reduce the losses in merchantable timber; 2, to insure protection of areas of scenic value; 3, under certain circumstances to curtail the development of a fire menace; and 4, to provide better insurance for timber growing enterprises.

II

Cooperation in Insect Control

Forest insect control involves many technicalities based on an intimate knowledge of the habits of the specific insect causing the damage. It likewise involves a detailed knowledge of the topography of the lands under control as well as close contacts with local labor and transportation facilities, which information is only available to the administrative officers on the ground. Due to this combined requirement for technical, entomological, and administrative knowledge, cooperation has been a necessary essential in all past control work.

The responsibility for the investigation of insects affecting forests or, in other words, the biological facts on which control rests has been invested by law in the Bureau of Entomology. This law further provides for the cooperation of the Bureau of Entomology with other federal agencies charged with the protection of Government lands and with private timberland owners. Details governing the mode of cooperation between the Bureau of Entomology and the Forest Service have been set forth in a memorandum of the Secretary of Agriculture, dated February 16, 1920. The methods therein stated have been interpreted as applying to other federal agencies as well. Briefly, the instructions state that the Bureau of Entomology shall be responsible for conducting surveys and for giving specific recommendations for control on the request of other federal agencies and for the assignment of an entomologist to the project during the period of control when conditions warrant. In actual practice the spirit of cooperation has exceeded the letter of the law. The Forest Service and National Park Service, as well as private owners, have aided the Bureau of Entomology by supplying field expenses or part of the salaries of entomologists engaged in control and the Bureau of Entomology has, from time to time, particularly in the case of the National Park Service, assumed more than its share of administrative duties. The chief handicap to the successful conduct of such cooperation has been the lack of trained personnel in the Bureau of Entomology.

Another form of cooperation is that involving the joint treatment of intermingled or adjacent lands under different ownership or administrative agency. Insects have no more respect for ownership boundaries than has fire, hence the necessity for coordinated suppression efforts. This need has been adequately and harmoniously met in the past by all Federal agencies.

The specific arrangements for cooperation in the control of epidemics on intermingled lands has varied greatly according to circumstances governing the situations. The most frequent form of cooperation has been between the National Park Service and the Forest Service. In this case one or the other agency usually assumes entire administrative responsibility, conducting control on the national forests and the national parks with the same crews and equipment. In some cases this has been effected through transfer of funds or again through a special appropriation providing for work on the lands of both organizations. During the past fiscal year an infestation on the Colorado National Forest and the Rocky Mountain National Park was treated. Here each organization utilized its own funds but there was close field cooperation involving transfer of leadership and treating crews trained by the Forest Service. When private timberlands have been involved there has usually been some agreement with the owners involving exchange of work on an area or tree basis. Sometimes an agreement will be drawn up covering details of operation. On one of the largest projects which has been undertaken - the so-called Oregon-California project which ran over a period of three years (1922, 1923 and 1924) and involved Forest Service, Office of Indian Service, public domain and privately owned lands - a special joint appropriation of $150,000 was made for control on Federal lands. To facilitate the work a board of control was appointed representing membership from each of these agencies and the Bureau of Entomology. Although the work was successfully carried out, it was found to involve more difficulties in administration than have been experienced in other projects where each agency had its own fund.

The chief limiting factor in successful cooperation of this type has been due to lack of funds of one or the other of the administrative agencies involved. Suggestions have been made from time to time looking toward a pooling of all Federal moneys to be used for insect-control work. It is felt from past experience that such a scheme would not be as effective nor as easily administered as the present method. Likewise proposals have been made suggesting that the Bureau of Entomology assume entire responsibility for the administration of all insect-control work. This would be entirely impractical due to the need for duplication of personnel and effort. In the final analysis a large part of the success of control operations lies in knowledge of local conditions possessed only by local administrative officers. The equipment for control is usually simple - such equipment as is kept on hand and available for fire fighting. If the Bureau of Entomology should take over this control it would mean the duplication of local personnel and equipment. The open season for insect control comes during a period of least fire hazard, that is, the winter months. Thus it is possible for a local organization to utilize the same personnel and equipment during one period of the year on fire detection and suppres-

sion and for the other portion of the year on insect control. The advantage of thus utilizing local personnel throughout the year is fully appreciated by private timberland owners and fire protection organizations, with the result that very effective systems combining fire suppression and insect control have resulted.

It is, therefore, the consensus of this board that the present methods of cooperation and coordination of effort in insect control are entirely satisfactory as far as they go. There is need of greatly strengthening this present effort, particularly by making available funds for coordinated attack when emergencies develop and for more adequate entomological supervision. This subject is treated at more length later.

III

Functions of the Bureau of Entomology

The functions of the Bureau of Entomology in respect to forest insects are three fold. These are 1, research or investigations; 2, extension of cooperative service; and 3, educational service. These activities are centered in the Division of Forest Insect Investigations. Before discussing the application of these functions to the present theme a brief sketch of the appropriations and history of this division will be given.

A separate subappropriation known as the Division of Forest Insect Investigations was set up in 1912 for the investigation of insects affecting forests. The first appropriation in 1912 provided $44,750 which has been gradually increased to $79,570 for the fiscal year 1928. Of this amount over half, or $41,000, is being expended during the fiscal year 1928 on a project known as Cooperative Forest Insect Control which embodies all the activities concerned in this report.

With these funds two permanent field stations are maintained, one at Palo Alto, Calif., the other at Coeur d'Alene, Idaho. During the field season temporary bases are established in the areas where the more important projects are under way. The personnel at these stations consists of 8 technical men, 2 scientific aids and 2 clerks.

Research. - The research activities of this Bureau consist of biological investigations into the habits of destructive or beneficial species of forest insects as a preliminary step toward development of methods of control. This function is especially important since all control methods hinge on the habits and activities of these insects. There are thousands of insects attacking forest trees, but only a few

are responsible for the primary damage. A great deal of study and effort is necessary to determine the activities of each of these species. Past efforts along these lines have resulted in the development of certain control procedures. These methods although effective are frequently too expensive to adopt under all circumstances. Further research aiming at improvement in control methods will undoubtedly lead to great reductions in present costs.

As an example of the practical results in improvement of control methods obtained through this type of research, a few illustrations are given.

For some time experimental studies of the use of the so-called sun-curing method for the destruction of barkbeetle broods have been made, but it was not until 1925 and 1926 that an opportunity became available to try this method on a large-scale control project. This was done in the Crater Lake National Park against the mountain pine beetle in lodgepole pine. The method gave very effective results and reduced previous costs about one half. This method, however, is not effective in more northern latitudes nor on north slopes. It is not practicable much farther north than southern Oregon and Colorado.

Detailed studies as to the exact environmental conditions within a tree necessary for normal development of barkbeetle broods demonstrated that with some species a high percentage of mortality can be obtained merely by felling the tree shortly after attack and cutting off the branches. It has not yet been possible to test this method on a large-scale project, but preliminary field tests have indicated its effectiveness. This method does away with the usual practice of barking the entire infested length of the tree and likewise greatly reduces cost.

The possibilities of tree medication for the control of barkbeetles have been experimentally tested for the past few years. This technique consists of injecting some poison or other chemical into the tree which prevents the development of the barkbeetle broods. It is too early, as yet, to try this method out on a large scale, but preliminary results have been very encouraging.

One of the greatest handicaps in this type of work is the lack of personnel for treating a sufficient number of trees in any one season to develop such possibilities as rapidly as would be desired.

Cooperative service in control. As mentioned under the previous heading, the Bureau of Entomology is authorized to act as a

clearing house on all technical matters pertaining to the technic and advisability of control. This service is rendered to all Federal agencies as well as to private timberland owners on request.

In accordance with the practices of cooperation which have been developed, these initial requests are referred to the Bureau of Entomology, whereupon an entomologist is dispatched to the area and a survey made of the situation. At the same time the losses of the year or two preceding are compared in order to determine the rate at which the infestation is increasing or declining. The information thus obtained forms the basis of a report to those entrusted with the supervision of the timber, together with a plan of control and an estimate of the funds required for the work.

The Bureau likewise provides technical supervision for all the larger control projects. A man is detailed to these projects for a period of time varying from a few days to the entire period of control, depending on the technicalities involved. The calls for this type of service in cooperation have increased so rapidly in recent years that these duties have had to be expanded at the expense of the research which forms the scientific basis for control technic. During the present fiscal year, approximately one-half of the money expended on this project has been devoted to the rendering of service to other agencies. There is, however, considerable gained by the Bureau of Entomology in this type of service, since it obtains a great amount of valuable information relative to the effectiveness of its control recommendations. In fact, it is only through testing of these methods in actual control that the shortcomings can be detected and steps taken leading toward improvement. Such problems as the percentage of a given infestation which must be treated to secure adequate control; the effect of control on a given area on adjacent untreated land and vice versa, the migration of destructive insects from one species of tree to another, the general effect and cost of maintenance control, can only be solved through actual control operations where entomologists and administrators are cooperating.

Educational service among cooperating agencies. Although the Bureau of Entomology assumes responsibility for the decision as to when control is necessary and for the methods to be applied, it is obvious that the more thoroughly the local administrative officers are instructed in these matters the better will be the results obtained. For this reason, the Bureau of Entomology has been devoting some effort to educational work among the field men of various agencies administering Federal lands. This field personnel in close contact with local conditions should be able to recognize insect outbreaks in the incipient stage and report to those competent to judge the seriousness of the situation. Consequently entomologists have

been dispatched to many of the district ranger camps maintained by the Forest Service and to the instruction meetings of the National Park Service. Leaflets of instructions and reports have been prepared and disseminated through the administrative personnel, and many local contacts have been made with the field men of other agencies. There is need of much greater expansion of this work, and there should be one or two men specially designated to handle and enlarge this educational and extension work.

IV

Functions of Land Managing Bureaus

The various Federal agencies administering timber lands are invested by law with the responsibility for the protection of these resources from fire, insects, diseases or other destructive forces. This responsibility as it applies to insect depredations implies 1, preliminary recognition of injury; 2, reporting of these situations to the Bureau of Entomology for expert advice; 3, control of these outbreaks. The methods of operation of these functions are briefly elaborated.

Preliminary recognition and survey of insect losses. The first step in insect protection is the recognition of an abnormal situation. This necessarily devolves upon the field personnel in close contact with the forest. The Forest Service for the past few years has demanded as part of the routine work of each Forest Supervisor that an annual report be made of the insect situation on the area under his charge. Such a formal survey has not yet been adopted in the other Federal land managing agencies but close contacts with the situation are maintained.

The reporting of insect situations for expert advice. Immediately upon the recognition of an incipient insect outbreak a report is made to the Bureau of Entomology requesting an examination by an entomologist and advice as to control procedure. This cooperative procedure has been explained elsewhere in more detail. In cases where the local personnel has had previous experience in recognition and control of insect outbreaks, an examination by the Bureau of Entomology is not always necessary although the situation is reported and the advisability as to control agreed upon through correspondence.

Control of insect outbreaks. The actual control of insect outbreaks is conducted by the land managing agencies by means of

funds specifically provided for that purpose. Preliminary to control, agreements as to the methods and extent of control are reached through conference with the Bureau of Entomology. A brief description of the organization of control projects is given to further explain this type of work.

Large projects require careful organization and not infrequently caching of supplies months ahead of actual work. The area to be treated is usually divided into units to facilitate transportation, location of camps and loss of time in travel. Two types of field crews are employed. The first, or marking crew, carefully surveys the infested territory, tags each infested tree and locates it on a map. The second, or treating crew, which follows, fells the tree and either peels the bark (thus exposing the immature stages of the barkbeetles beneath) or removes the bark and burns it, (in the case of those species living within the bark). Variations of this procedure for the sake of economy are frequent. In dense stands of lodgepole pine, for instance, it is often possible to fell a group of trees together and burn the entire pile. Again they may be barked (by the use of spuds) or burned standing. In some cases effective control can be obtained through the use of the sun's heat. This involves the felling of the trees and the turning of the logs at one or two days' intervals to insure the heating all portions of them by the sun's rays.

The preceding methods apply to localiites in which it is not economically possible to utilize the destroyed timber. The Forest Service, the National Park Service, and private timberland owners recognize the economy of combining insect control with utilization wherever it is possible. During recent years the Forest Service has controlled a number of incipient outbreaks of the mountain pine beetle, spruce barkbeetle and the Douglas-fir beetle in District No. 4 through disposal to purchasers or permittees. If necessary, in order to move it, the infested timber is either given away or sold at a nominal price, but in any event the contracting party must handle it according to specified methods that will destroy the barkbeetle broods. Specially notable examples of large scale control operations combined with utilization have been profitably conducted by the Long Bell Lumber Company in Oregon. On the valley floor of the Yosemite National Park and near certain camps in Yellowstone National Park local authorities have been utilizing "bug trees" as fuel wood for the past five years and at the same time effectively reducing the infestation. Such means of control will be increasingly more feasible in the future as the timber becomes more accessible and will gradually reduce the amount of money needed for suppression.

In the case of defoliating insects where spraying or dusting with arsenicals is necessary for control, more of the responsibility for supervision is assumed by the Bureau of Entomology as in the case of the control of lodgepole pine defoliations in Yellowstone National Park.

V

Present Status of Each Bureau in Relation to Insect Danger

Volume and character of timber in need of protection. There are two distinct classes of timber lands needing protection from insect pests - those where a present or future commercial value is the chief consideration and those where the esthetic values are predominant. A third class, the so-called watershed or protection forest, is not included in the present consideration except when the infestation threatens other timber of greater value. The commercially valuable timber includes that on lands of the national forests, indian reservations, and public domain. The timber needing protection because of its esthetic values lies in the national parks and on small recreational areas of the national forests.

The following table gives the volume, in board feet, of the stands of saw timber on the national forests, indian reservations and public domain. No such estimates are available for the national parks - consequently in the second table the area of timber types in the national parks subject to insect attack are listed.

Stands of Saw Timber Liable to Controllable Insect Depredations in National Forests, Indian Reservations and Public Domain.

(Thousands of board feet)

	National Forest	Ind. Res.	Pub. Domain
Western yellow pine	107,781,000	18,000,000	**
Sugar pine	13,858,000		
Western white pine*	7,000,000		
Lodgepole pine	36,531,000	1,500,000	
Engelmann spruce	27,884,000	500,000	
Jeffrey pine	1,259,000		
Doublas fir (Rocky Mountain region)	23,522,000	1,000,000	
Total	217,835,000	21,000,000	

* Mostly Pinus monticola, but also includes P. flexilis, P. albicaulis, P. aristata, and P. strobiformis.

** No figures available, but 100,600 acres of white pine type occur on public domain in northern Idaho, western Montana and eastern Washington.

Area of timber type subject to insect infestation in the National Parks.

	Acres
Yellowstone	1,607,030
Grand Canyon	110,000
Glacier	785,280
Rocky Mountain	123,000
Crater Lake	116,000
Lafayette	7,500
Rainier	101,000
Sequoia	226,000
Lassen	51,000
Mesa Verda	33,600
Yosemite	550,000
Zion	76,800
Total	3,787,210

History of Control - Forest Service. The first attempt to control a barkbeetle infestation by direct control measures was undertaken on a small scale in 1906 on the Black Hills National Forest. From then until 1920 a series of projects were carried on in the West from funds apporpriated for protection of the forests. The largest operation during this period was carried out on the Whitman National Forest in Oregon which involved an expenditure of about $30,000.

With the development of serious western pine beetle epidemics in southern Oregon and northern California in 1920, involving valuable private holdings as well as National Forest and Indian Reservation timber, the necessity for special funds to meet the situation became apparent. Through the initiative of private interests, a special deficiency appropriation of $150,000 in 1922 was secured to carry out control work on the Indian Reservation, the National Forests, recaptured Oregon and California railroad grant lands and the public domain in cooperation with private lands in this area. Of this amount approximately $36,500 was allotted for work on the Klamath Indian Reservation. In 1923 the development of a serious Black-Hills-beetle epidemic on the Kaibab National Forest and the Grand Canyon National Park created a similar emergency, and a deficiency of $50,000 was secured for this project. A similar situation has also been created by the Big Hole project in 1926 for which a deficiency appropriation of $50,000 was secured.

Meanwhile, in 1924, an authorization to expend not over $25,000 of the fire suppression appropriation specifically for insect control work was secured to be used in the control of insect infestations on National Forests. While this amount was inadequate to meet current

situations, it enabled the Forest Service to develop a definite policy toward this work. This was later increased to $58,000 in 1927 and to $75,000 in 1928. For the fiscal year 1929, the appropriation bill as passed by Congress transferred this amount to the appropriation for the administration and protection of the National Forests.

National Park Service. Control of insect infestations was first started in 1913 in the Yosemite National Park when an allotment of $1,168 was made from the revenues of the Park to control a mountain pine beetle outbreak in lodgepole pine. Small appropriations were made during the period from 1913 to 1921 for control of areas of infestation on the Yosemite and Sequoia National Parks. In 1924 a serious defoliation of lodgepole pine on the Yellowstone and heavy barkbeetle epidemics on the Grand Canyon and Crater National Parks forcibly emphasized the need of an adequate fund to meet these situations. A special appropriation of $25,000 for the fiscal year 1925 was secured which was distributed among the three Parks involved. This fund was reduced in 1927 to $7,000 and for 1928 $9,000 was available.

Office of Indian Affairs. In 1912 an outbreak of mountain pine beetle was controlled with an allotment of $903 on the Tongue River Indian Reservation. No further allotments were made until 1922 when the deficiency appropriation secured by the Forest Service was made available for work on the Klamath Indian Reservation.

The Bureau of Biological Survey and Public Domain. No insect situations calling for investigation or control action have been reported from the lands under control of the Bureau of Biological Survey or Public Domain.

In the following table are tabulated the annual expenditures for insect control by each Federal agency and for private operations as well.

Money expended for Forest Insect Control

Fiscal Year	Office of Indian Affairs	Forest Service	National Park Service	Private Owners
1906		$ 2,700		
1907		2,589		
1908		2,500		
1909		50		$ 225
1910		24,452		
1911		15,040		5000
1912	$ 903	23,434		918
1913		446	$1,168	906
1914		22,452	2,770	3697
1915		7,939		3634
1916		10,535		4615
1917		15,004		4638
1918		2,557	1,857	10000
1919		2,502	395	8000
1920		9,735	125	17135
1921		20,905	375	21195
1922	12,000	62,082		6638
1923	12,000	56,381		33607
1924	12,000	44,465	7,313	17150
1925		40,522	25,000	45874
1926		31,153	20,000	18443
1927		67,601	7,500	18231
	$36,903	$464,944	$66,503	$219906

Total $788,256.

Outstanding insect situations. Under introductory remarks attention was called to the insect losses in the timber lands west of the Mississippi. It is estimated that approximately 5,000,000,000 feet of pine, spruce and Douglas fir are killed annually on intermingled public and privately owned timberlands. At least one half of this loss is on Federal lands.

Annual surveys of losses resulting from the attack of the western pine beetle in the heart of the western yellow pine district of southern Oregon and northern California have been conducted since 1918 on an area of over 2,000,000 acres. The annual losses from 1918 to 1926, inclusive, have ranged from 0.5 to over 3 per cent of the stand, or a total of 12 per cent of the stand has been killed in

9 years, representing 1,500,000,000 feet of high-grade merchantable lumber. The ownership involved in this area is largely private, but National Forest, Indian Reservation, and Public Domain are involved.

Another area just south of this centering about the Modoc National Forest, involving both Government-owned and private lands, was surveyed from 1921 to 1927 inclusive. During this period of 7 years a total of 9.17 per cent of the stand has been destroyed, representing 506,000,000 board feet. There has been a gradual increase of the infestation in this region from 0.4 per cent in 1923 to over 3 per cent in 1927. Although the timber here is not so readily accessible as that in the Klamath Lake regions, it does represent a body of high-grade merchantable timber.

In 1909 attention was called to an increasing epidemic of the mountain pine beetle in the Flathead National Forest, Mont. It centered largely in inaccessible timber along the west side of the Continental Divide, and it was not deemed advisable to attempt control at that time. Since then the epidemic has been increasing and gradually moving southward through the Missoula and Bitterroot National Forests until it now centers on the west side of the Continental Divide near the Montana-Idaho boundary line. Although here in the Bitterroot some merchantable lodgepole pine was threatened, the infestation has reached such stupendous proportions that it would be almost a physical impossibility to attempt control.

An idea of the magnitude of this infestation can be obtained from a picture of the center of the infested area involving about 20 square miles. Here in 1926 some 50,000 trees were infested on every square mile. Present costs of control at $2.00 per tree would require $2,000,000 to thoroughly clean up the area. This infestation in 1925 began sweeping across to the eastern slopes of the Continental Divide on the Beaverhead National Forest. In the spring of 1928, approximately 65,000 infested trees were treated on this slope but even this effort failed to stem the advance. The justification for control work here was based on the hope that it would prevent the continued southward spread of this epidemic into the great mass of lodgepole timber in the Yellowstone National Park and surrounding National Forests and on the higher commercial value of the lodgepole timber on the eastern slope of the Divide compared with that on the western slope.

The situation in the National Parks is at the present moment somewhat better. A moderately small outbreak of the Black Hills beetle on the Rocky Mountain National Park and adjacent National Forest and privately owned lands threatened much timber. Recent

control operations, however, completely suppressed this outbreak. For the past four years a severe epidemic of defoliating insects has destroyed many square miles of lodgepole pine and Douglas fir timber in the Yellowstone National Park. Spraying operations were initiated along the main highways and around camping sites with the result that this timber is largely protected. Such operations may be necessary from time to time, but it is believed that the epidemic is now subsiding and that this year's work will result in complete control on this project. The infestation of the mountain pine beetle in lodgepole pine which destroyed a great quantity of timber on the Crater Lake National Park has likewise been vigorously attacked for the past three years and it now appears that the lodgepole stand on this park will not be wiped out as is the case on the national forest just north of Crater Lake.

Referring again to the Yellowstone Park, there is a great mass of lodgepole pine ripe for a barkbeetle epidemic which will inevitably develop in this area, and, judging from our past experience with this beetle under similar conditions, a great proportion of the lodgepole pine will be destroyed unless prompt measures for control are initiated at the first signs of the outbreak.

It is of course a physical impossibility to completely control all of these epidemics which are now threatening the Government-owned timber. Such a program would involve an appropriation of over $3,000,000, and labor could not be obtained locally to conduct operations on such a large scale. The best that can be done is to extend protection to the most valuable portions of these stands until these epidemics die down, and to make preparations for the future to prevent the development of epidemics on such a large scale.

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